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Yamazaki

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(54) **PRINTING APPARATUS**

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G06K 15/00 (2006.01)
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/553*** (2013.01); ***G03G 15/5087*** (2013.01); ***G03G 15/55*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,972,857	B2 *	12/2005	Mantell et al.	358/1.14
7,193,741	B2 *	3/2007	Nozaki	358/1.16
2001/0043258	A1	11/2001	Ohki	
2005/0276619	A1	12/2005	Taguchi et al.	
2006/0275057	A1 *	12/2006	Suzuki	399/301
2007/0216937	A1 *	9/2007	Tsutsumi	358/1.15
2008/0055660	A1	3/2008	Tsuzuki	
2008/0266587	A1 *	10/2008	Mita	358/1.9
2009/0080006	A1	3/2009	Aoki	
2009/0190947	A1 *	7/2009	Kushida	399/72
2009/0284770	A1 *	11/2009	Nagayama et al.	358/1.9

FOREIGN PATENT DOCUMENTS

JP	2000-155453	6/2000
JP	A-2001-103203	4/2001
JP	A-2002-229278	8/2002

(Continued)

OTHER PUBLICATIONS

Notification of Reasons for Refusal dated Oct. 20, 2011 received from the Japanese Patent Office from related Japanese Application No. 2009-298187, together with an English-language translation.

(Continued)

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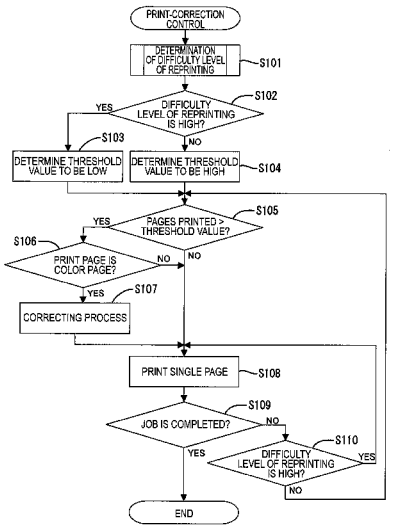
(57) **ABSTRACT**

A printing apparatus including: a plurality of reception units, wherein at least one of the plurality of reception units receives a printing job; a printing unit that performs printing based on the printing job received by the at least one of the plurality of reception units; a determination unit that determines a difficulty level of reprinting based on which of the plurality of reception units received the printing job; a setting unit that sets a correction-performing condition based on the determined difficulty level of reprinting, wherein the correction-performing condition becomes easier to satisfy as the determined difficulty level of reprinting increases; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image to be printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

2 Claims, 8 Drawing Sheets



(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2005-62414	3/2005
JP	A-2006-259068	9/2006
JP	A-2008-060931	3/2008
JP	A-2008-72619	3/2008
JP	A-2008-298867	12/2008
JP	A-2009-80157	4/2009

OTHER PUBLICATIONS

Decision of Patent Grant dated May 22, 2012 received from the Japanese Patent Office from related Japanese Application No. 2009-298187, together with an English-language translation.

* cited by examiner

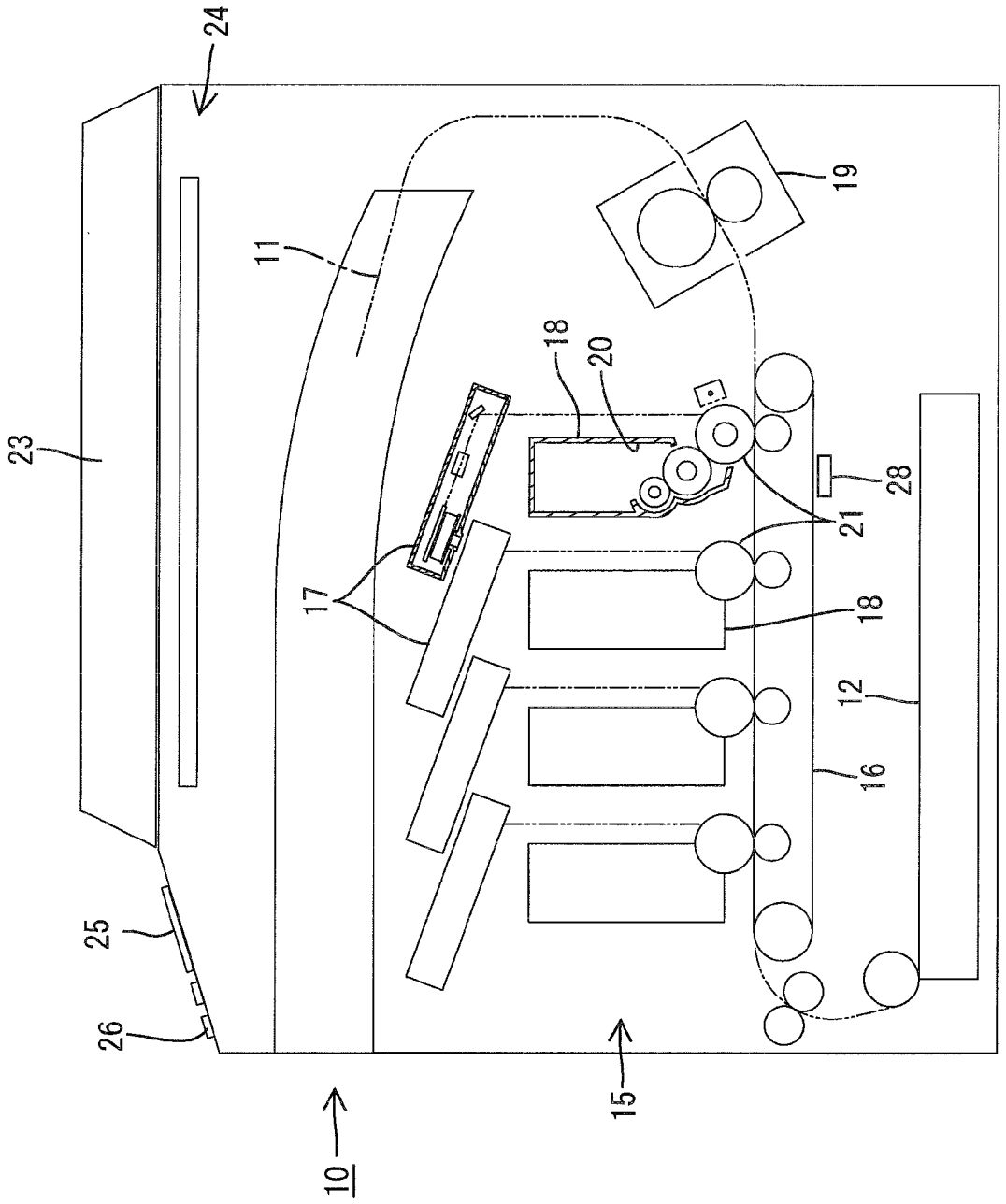


FIG. 1

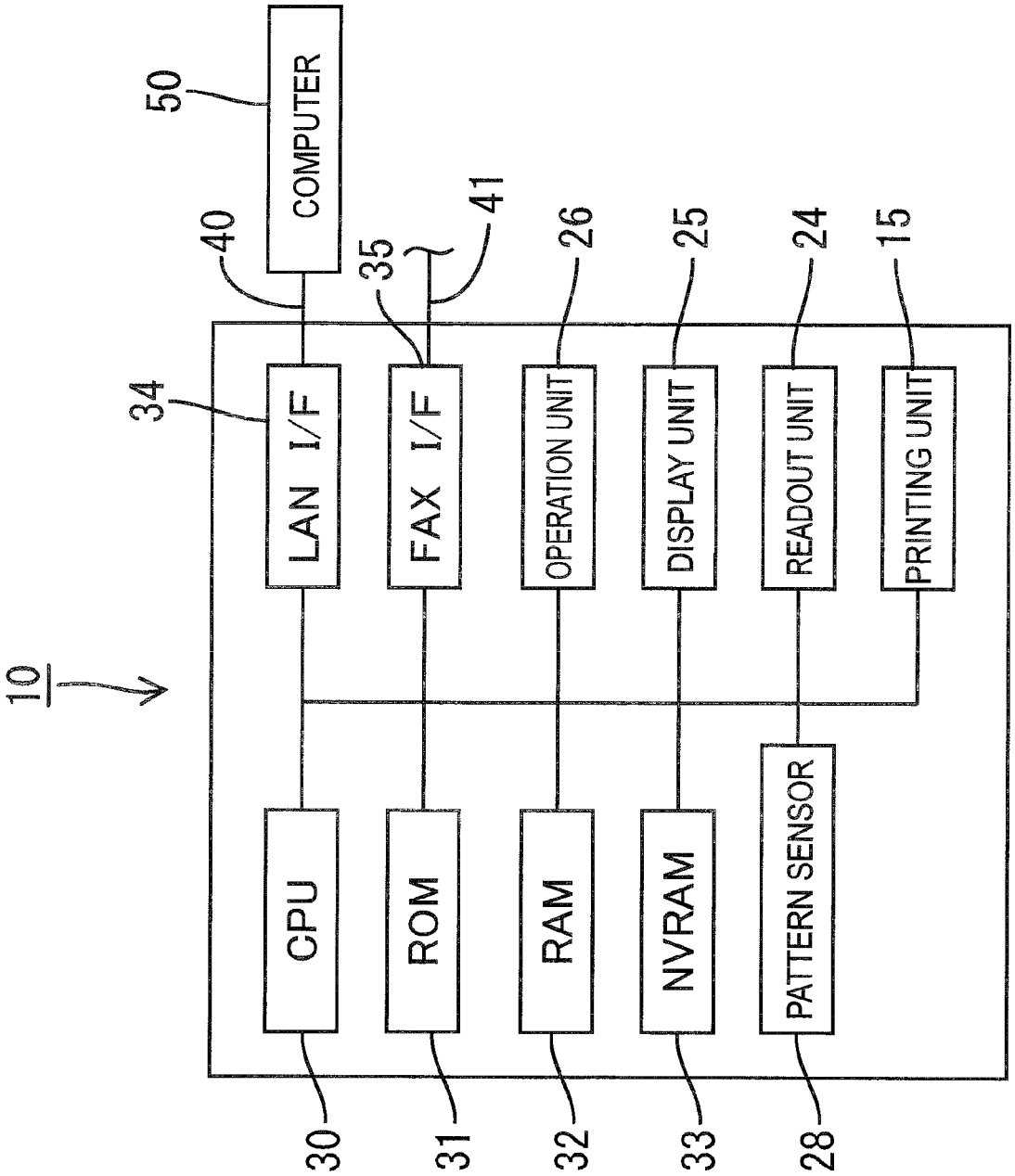

10
50
COMPUTER
40
35
41
26
25
24
15
34
LAN I/F
FAX I/F
OPERATION UNIT
DISPLAY UNIT
READOUT UNIT
PRINTING UNIT
CPU
ROM
RAM
NVRAM
PATTERN SENSOR
30
31
32
33
28

FIG. 2

FIG. 3

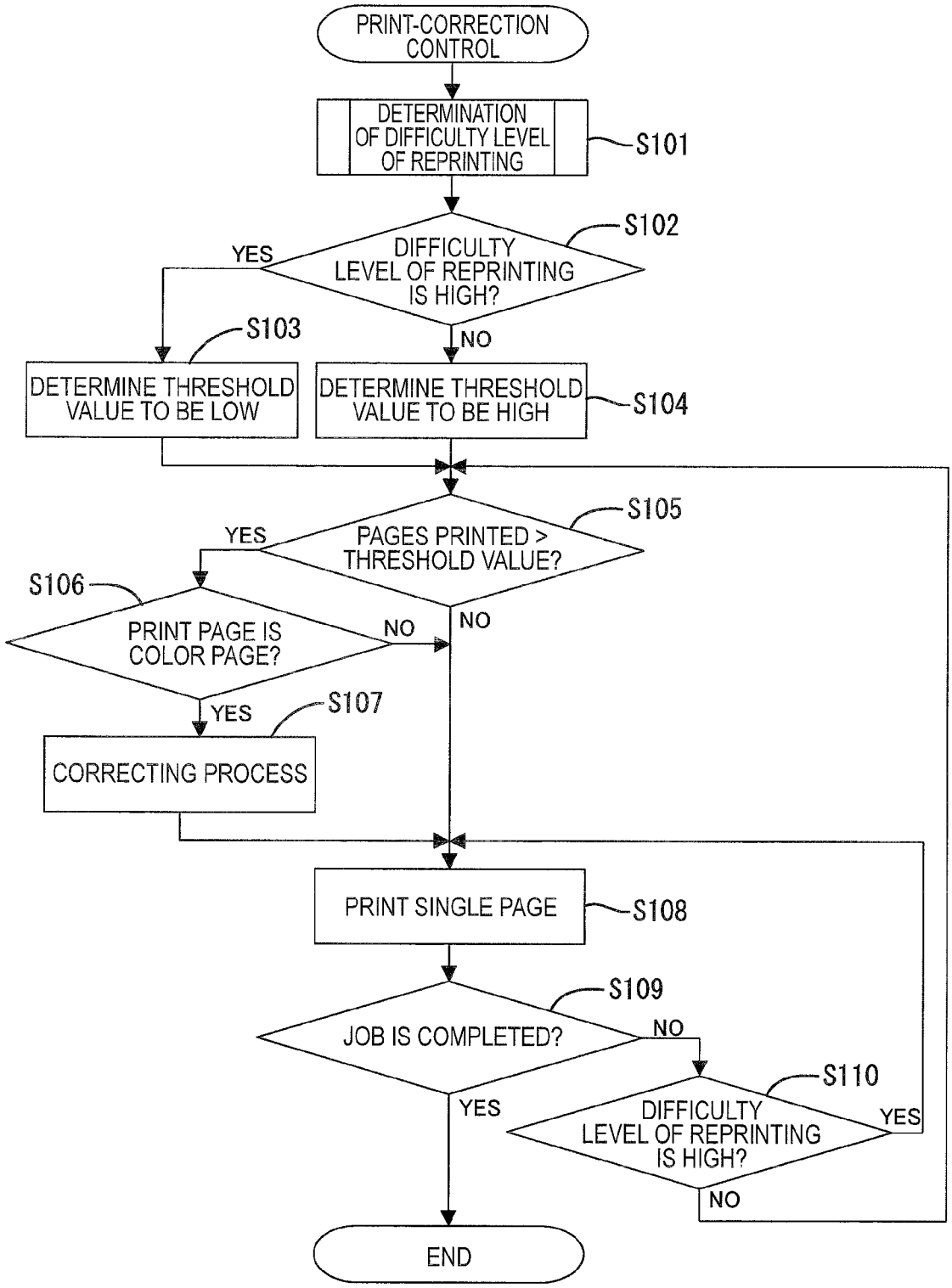

PRINT-CORRECTION CONTROL
DETERMINATION OF DIFFICULTY LEVEL OF REPRINTING
S101
DIFFICULTY LEVEL OF REPRINTING IS HIGH?
S102
YES
NO
DETERMINE THRESHOLD VALUE TO BE LOW
S103
DETERMINE THRESHOLD VALUE TO BE HIGH
S104
PAGES PRINTED > THRESHOLD VALUE?
S105
YES
NO
PRINT PAGE IS COLOR PAGE?
S106
NO
YES
CORRECTING PROCESS
S107
PRINT SINGLE PAGE
S108
JOB IS COMPLETED?
S109
NO
YES
DIFFICULTY LEVEL OF REPRINTING IS HIGH?
S110
YES
NO
END

FIG. 4

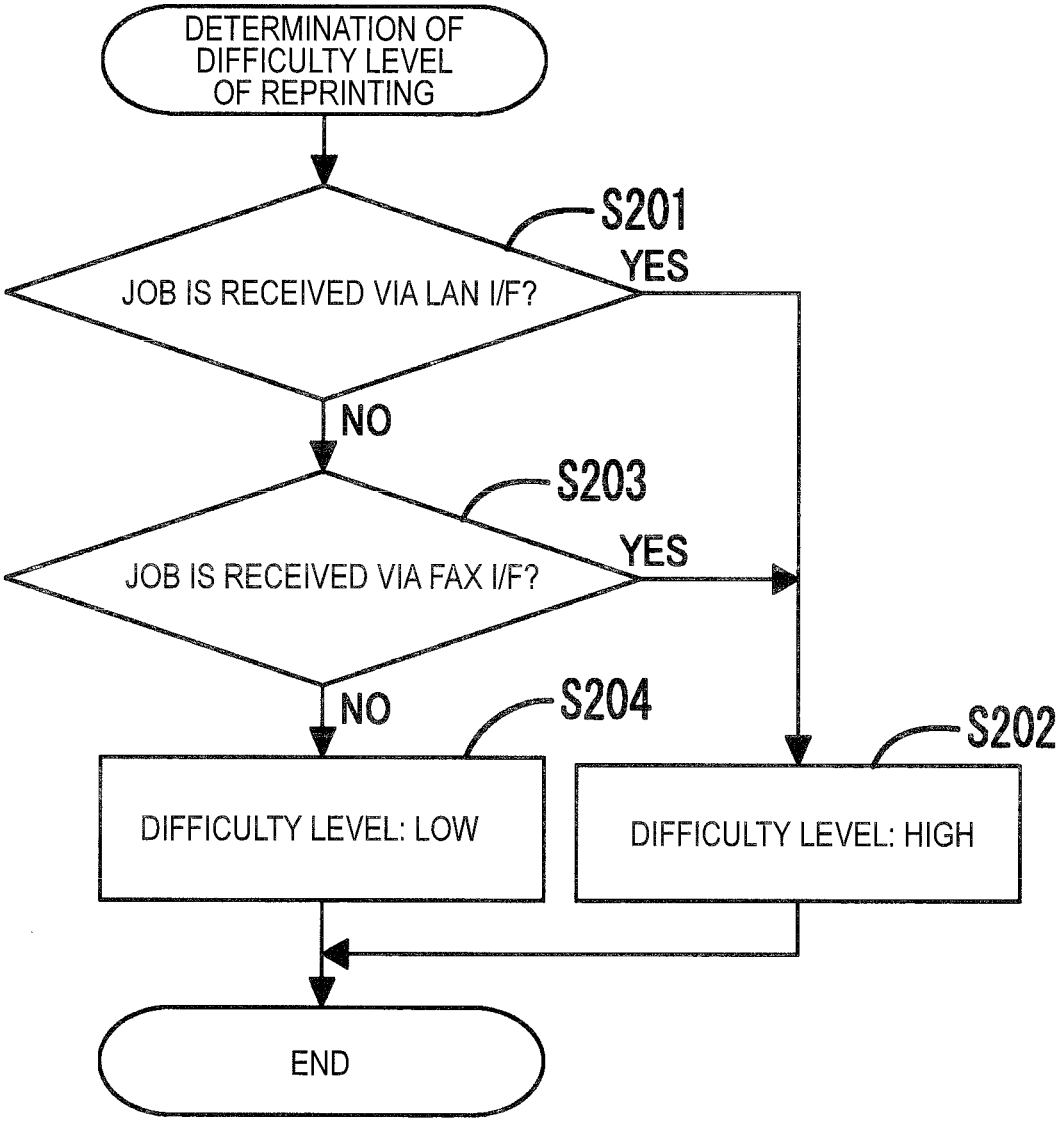

DETERMINATION OF DIFFICULTY LEVEL OF REPRINTING
S201
JOB IS RECEIVED VIA LAN I/F?
YES
NO
S203
JOB IS RECEIVED VIA FAX I/F?
YES
NO
S204
S202
DIFFICULTY LEVEL: LOW
DIFFICULTY LEVEL: HIGH
END

FIG. 5

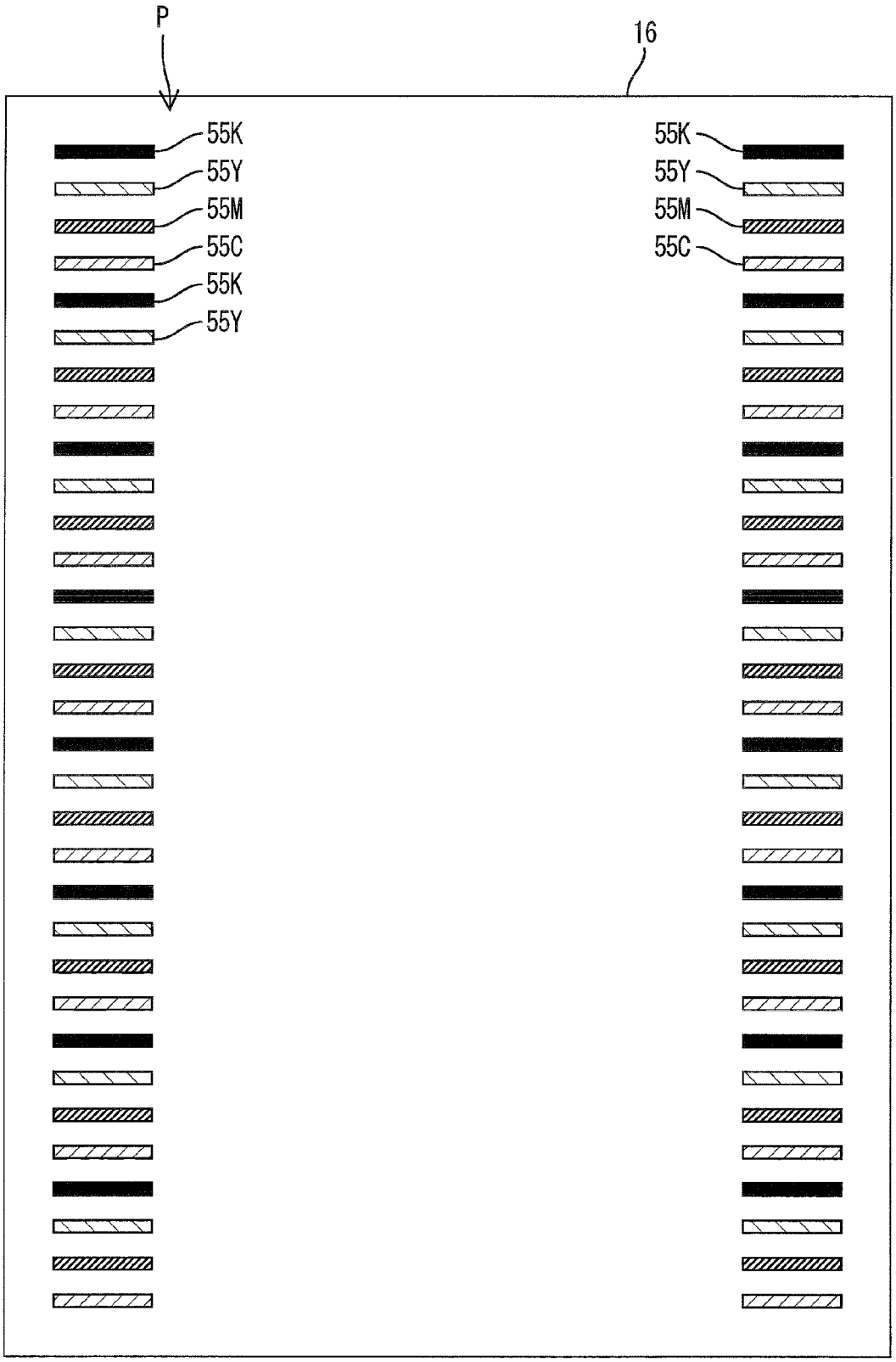
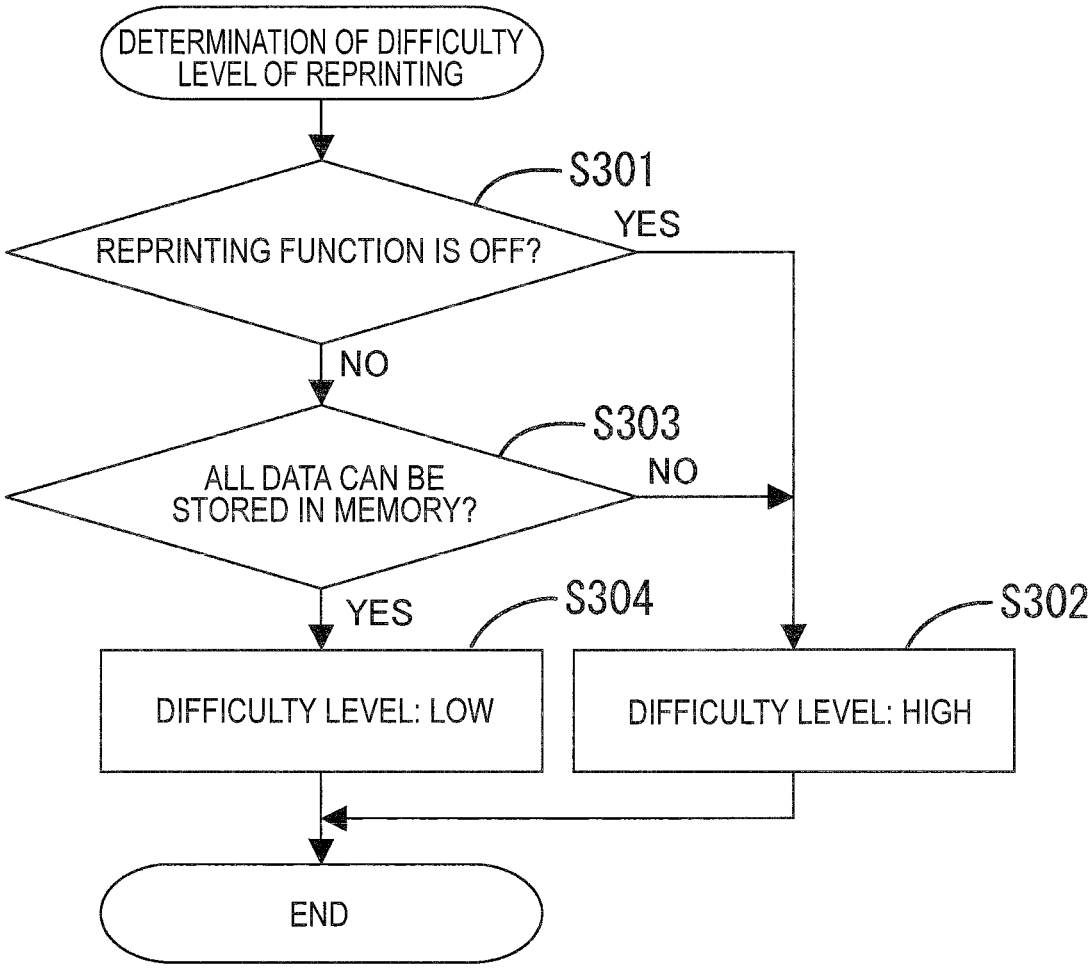


FIG. 6


DETERMINATION OF DIFFICULTY LEVEL OF REPRINTING
S301
REPRINTING FUNCTION IS OFF?
YES
NO
S303
ALL DATA CAN BE STORED IN MEMORY?
NO
YES
S304
S302
DIFFICULTY LEVEL: LOW
DIFFICULTY LEVEL: HIGH
END

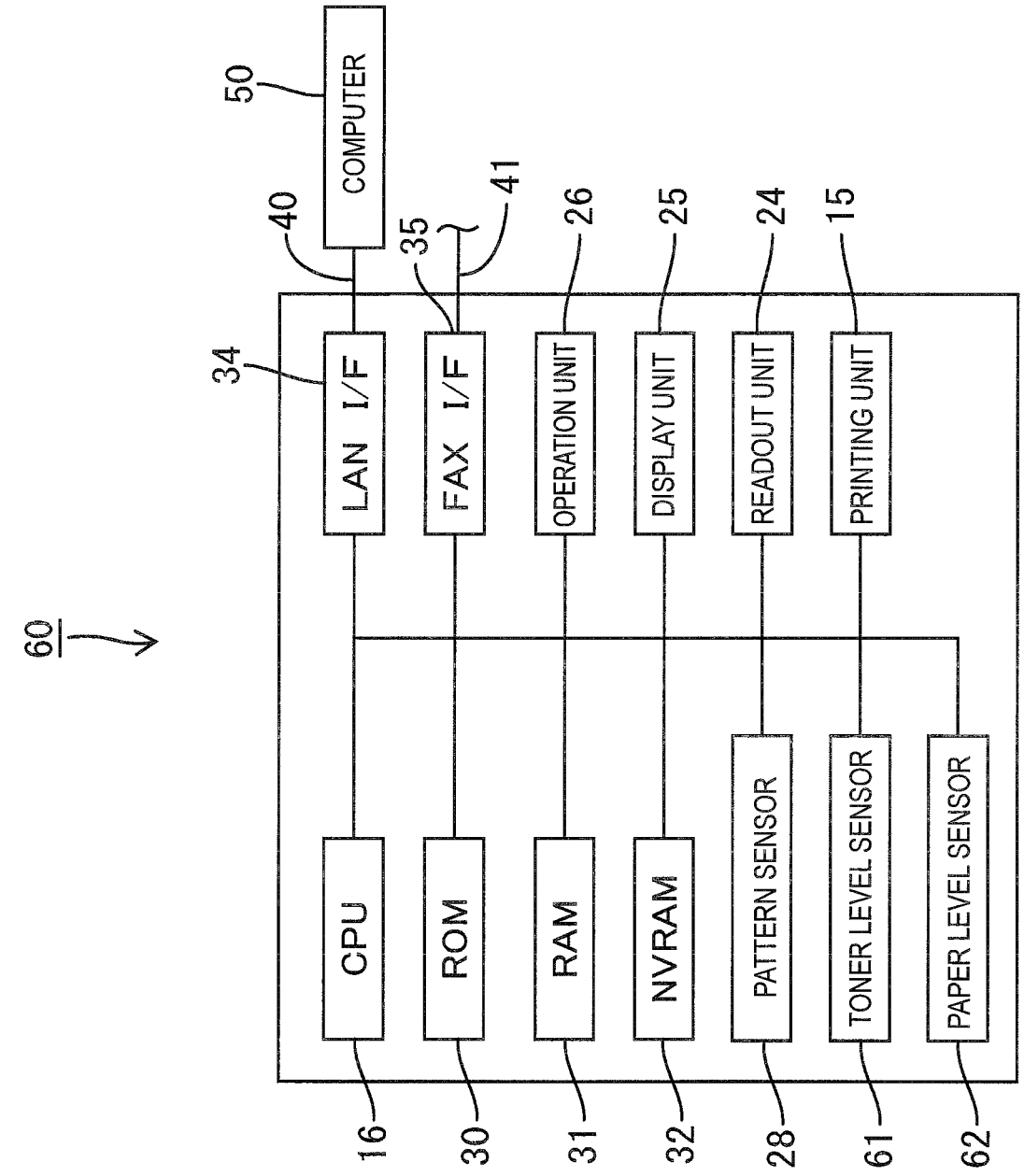
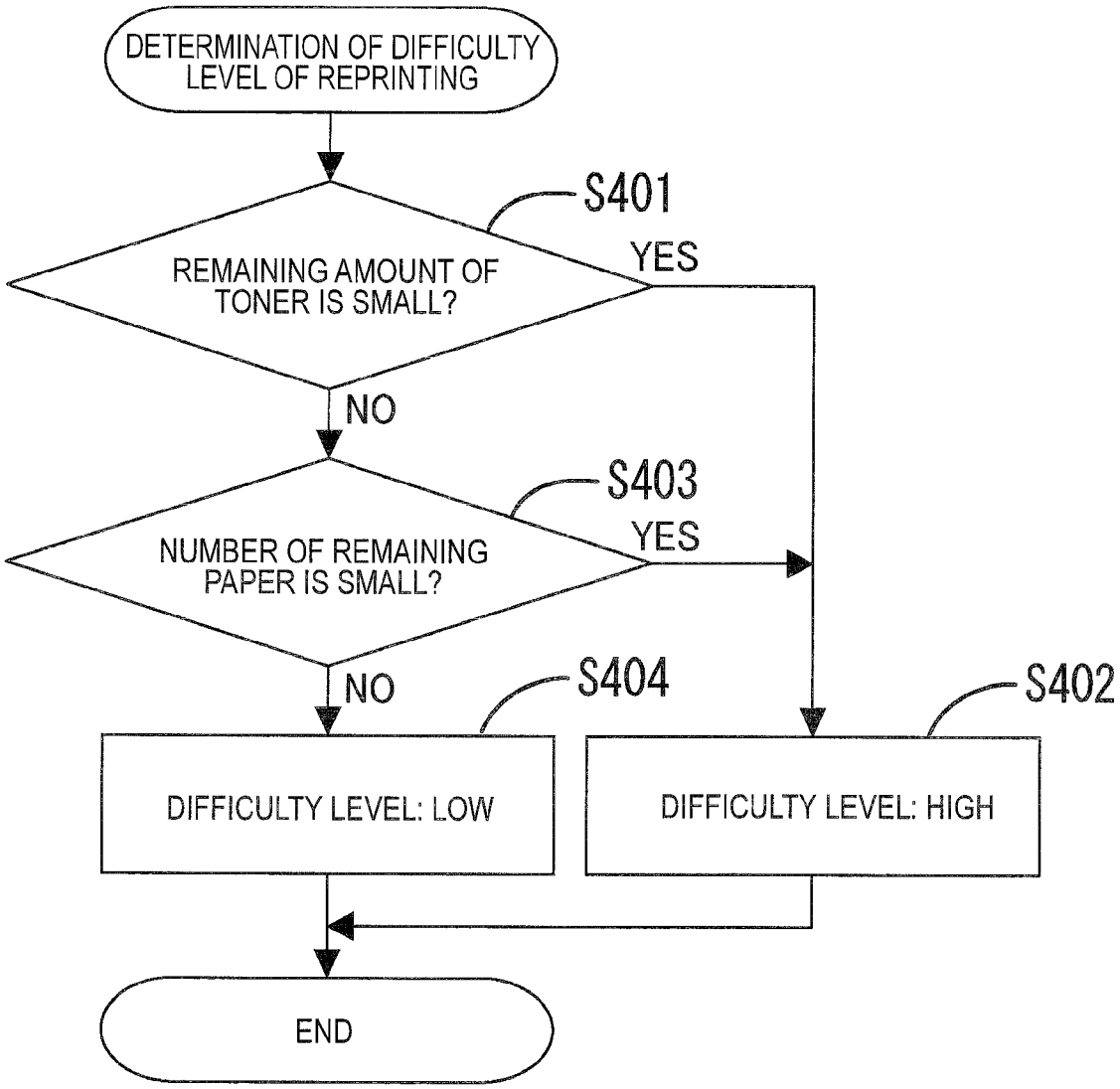

60
50
COMPUTER
40
35
41
26
25
24
15
34
LAN I/F
FAX I/F
OPERATION UNIT
DISPLAY UNIT
READOUT UNIT
PRINTING UNIT
CPU
ROM
RAM
NVRAM
PATTERN SENSOR
TONER LEVEL SENSOR
PAPER LEVEL SENSOR
16
30
31
32
28
61
62

FIG. 7

FIG. 8


DETERMINATION OF DIFFICULTY LEVEL OF REPRINTING
S401
REMAINING AMOUNT OF TONER IS SMALL?
YES
NO
S403
NUMBER OF REMAINING PAPER IS SMALL?
YES
NO
S404
S402
DIFFICULTY LEVEL: LOW
DIFFICULTY LEVEL: HIGH
END

PRINTING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from Japanese Patent Application No. 2009-298187 filed on Dec. 28, 2009, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

Aspects of the present invention relate to a printing apparatus, and more particularly, to a printing apparatus having a function of correcting position and density of an image.

BACKGROUND

There has been proposed a related-art printing apparatus having a function of correcting position and density of an image. When receiving a printing job, such a related-art printing apparatus carries out a correcting process by determining whether or not a certain condition to perform a correcting process is satisfied, e.g. whether or not the number of print pages that was printed out throughout a previous correcting process reaches a certain value, or the like, and if it is determined YES, performs a correcting process. In the correcting process, a print unit prints a certain pattern, measures the pattern, and corrects position and density of an image based on a result of measuring the pattern. By executing a printing job after the correcting process, high quality image can be ensured.

Meanwhile, since the correct process also leads to disadvantages such as an increase in consumption of a print toner and an increase in a user's waiting time, it is unfavorable to perform the correcting process frequently. However, the user likely to become more dissatisfied to quality of a printed image as the period during which the correcting process is not performed becomes longer.

In such a case, a user can obtain a high quality image by instructing the related-art printing apparatus to perform a correcting process and by reprinting a corrected image after the correcting process. However, such reprinting may be difficult to perform or may be troublesome according to situations. In the related-art, convenience for the user according to such situations was not considered.

SUMMARY

Accordingly, it is an aspect of the present invention to provide a printing apparatus that is capable of improving convenience for the user in performing a reprinting process under situations that the reprinting process is difficult to perform or is troublesome.

According to an aspect of the present invention, there is provided an printing apparatus comprising: a plurality of reception units, wherein at least one of the plurality of reception units receives a printing job; a printing unit that performs printing based on the printing job received by the at least one of the plurality of reception units; a determination unit that determines a difficulty level of reprinting based on which of the plurality of reception units received the printing job; a setting unit that sets a correction-performing condition based on the determined difficulty level of reprinting, wherein the correction-performing condition becomes easier to satisfy as the determined difficulty level of reprinting increases; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image to be printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

According to another aspect of the present invention, there is provided a printing apparatus comprising: a reception unit that receives a printing job; a printing unit that performs printing based on the printing job received by the reception unit; a reprinting unit that is capable of performing a reprinting process for reprinting an image printed by the printing unit based on a command from a user; a determination unit that, if the reprinting process by the reprinting unit cannot be performed, determines a difficulty level of reprinting to be higher than the difficulty level of reprinting when the reprinting process can be performed; a setting unit that sets a correction-performing condition to be easier to be satisfied when the difficulty level determined by the determination unit is higher than the difficulty level of reprinting when the reprinting process can be performed; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image which is to be printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

According to another aspect of the present invention, there is provided a printing apparatus comprising: a reception unit that receives a printing job; a printing unit that performs printing using a consumable print material based on the printing job received by the reception unit; a detection unit that detects the amount of consumable print material remaining; a determination unit that determines a difficulty level of reprinting based on the amount of consumable print material remaining, wherein the determined difficulty level of reprinting increases as the amount of consumable print material remaining decreases; a setting unit that sets a correction-performing condition based on the determined difficult level of reprinting, wherein the correction performing condition becomes easier to satisfy as the determined difficulty level of reprinting increases; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image which is printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

According to another aspect of the present invention, there is provided a printing apparatus comprising: a plurality of reception units, wherein at least one of the plurality of reception units receives a printing job; a printing unit that performs printing based on the printing job received by the at least one of the plurality of reception units; a modifying unit that modifies a difficulty level of satisfying a correction-performing condition based on which reception unit receives the printing job; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image which is printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

According to another aspect of the present invention, there is provided a printing apparatus comprising: a reception unit that receives a printing job; a printing unit that performs printing based on the printing job received by the reception unit; a reprinting unit that is capable of performing a reprinting process for reprinting an image printed on the printing unit based on a command from a user; a modifying unit that, if the reprinting process by the reprinting unit cannot be performed, modifies a correction-performing condition to be easier than the correction-performing condition when the reprinting process can be performed; and a correction unit that performs a correcting process by causing the printing unit

to form a pattern and by correcting an image which is printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

According to another aspect of the present invention, there is provided a printing apparatus comprising: a reception unit that receives a printing job; a printing unit that performs printing using a consumable print material based on the printing job received by the reception unit; a detection unit that detects the amount of consumable print material remaining; a modifying unit that modifies a correction-performing condition based on the amount of consumable print material remaining, wherein correction-performing condition becomes easier to satisfy as the amount of consumable print material remaining decreases; and a correction unit that performs a correcting process by causing the printing unit to form a pattern and by correcting an image which is printed based on a result of measuring the pattern, if the correction-performing condition is satisfied when the printing job is received.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a side cross-sectional view illustrating the schematic configuration of a printer according to a first exemplary embodiment of the present invention;

FIG. **2** is a block diagram schematically illustrating an electrical configuration of a printer;

FIG. **3** is a flow chart illustrating a procedure of a print-correction controlling process;

FIG. **4** is a flow chart illustrating a procedure of a process to determine difficulty level to perform reprinting;

FIG. **5** is a plan view illustrating a pattern for a correcting process;

FIG. **6** is a flow chart illustrating a process to determine difficulty level to perform reprinting according to a second exemplary embodiment of the present invention;

FIG. **7** is a side cross-sectional view illustrating the schematic configuration of a printer according to a third exemplary embodiment of the present invention; and

FIG. **8** is a flow chart illustrating a process to determine difficulty level to perform reprinting according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

First Exemplary Embodiment

The first exemplary embodiment will now be described with reference to FIGS. **1** to **5**.

Overall Configuration of Printer

FIG. **1** is a side cross-sectional view of a printer **10** which is an example of a printing apparatus of the invention. The printer **10** is a color combined machine having a function such as printing, scanning, copying, faxing, and the like.

The printer **10** includes a feed tray **12**, which can store paper sheets **11** (an example of consumable print materials) therein, and from which the paper sheet **11** is fed to a printing unit **15**. The printing unit **15** (an example of printing unit) includes a conveyor belt **16**, four light-emitting units **17**, four processing units **18**, and a fuser **19**.

The four processing units **18** each include a toner bin **20** that stores colored toner (an example of consumable print materials), typically black K, yellow Y, magenta M, or cyan C toners, and a photosensitive drum **21**. In the printing process, the light-emitting unit **17** irradiates the circumferential surface of the charged photosensitive drum **21** of the respective processing unit **18** to form an electrostatic latent image. Then, toner is supplied to the electrostatic latent image and the image is developed. Sequentially, the toner image is transferred from the respective processing units **18** to the paper sheet **11** carried over the conveyor belt **16**. Then, the fuser **19** heats the paper sheet **11** to fuse the toner, and the paper sheet **11** is ejected.

On the printer **10**, a readout unit **24** having an auto document feeder (ADF) **24** is provided. The readout unit **24** reads out the document sheet and obtains the readout data. On the front upper surface of the readout unit **24**, a display unit **25** and an operation unit **26** are provided. The display unit **25** may include a display, a lamp, or the like and is capable of displaying various setting screens, an operation state of an apparatus, or the like. The operation unit **26** (an example of reception unit and non-facsimile receiver unit) may include a plurality of buttons and is capable of performing an input operation such as user's instructions on implementation of a job, or the like.

Further, the printer **10** includes a pattern sensor **28** for use in a correcting process which will be described later. The pattern sensor **28** is provided below the conveyor belt **16**. The pattern sensor **28** receives light emitted to the conveyor belt **16** and for example, detects a pattern formed on a surface of the conveyor belt **16** based on amount of the emitted light.

Electrical Configuration of Printer

FIG. **2** is a block diagram of an electrical configuration of the printer **10**.

The printer **10** includes a CPU **30**, a ROM **31**, a RAM **32**, and a non-volatile RAM (NVRAM) **33**, as shown in FIG. **2**. The ROM **31** stores therein a program for executing a variety of operations of the printer **10** such as printing, correction-performing processing, or the like, which will be described later. The CPU **30** (an example of a determination unit, a setting unit, a correction unit, a reprinting unit, and a modifying unit) performs various processing operations according to the program readout from the ROM **31**, and controls the respective units while storing the processing results in the RAM **32** or NVRAM **33**. Such a configuration is electrically connected to the aforementioned printing unit **15**, readout unit **24**, display unit **25**, operation unit **26**, pattern sensor **28**, and the like.

The printer **10** includes a network interface **34** and a facsimile interface **35**. The network interface **34** (an example of reception unit and non-facsimile receiver unit) is connected to an external computer **50** or the like via a data line **40**. Therefore, the printer **10** and the external computer **50** or the like are able to data-communicate with each other. The facsimile interface **35** (an example of reception unit and facsimile receiver unit) is capable of transmitting and receiving facsimile data to or from an external facsimile device (not shown) via a telephone line **41**.

Print-Correction Controlling Process

FIG. **3** is a flow chart of a procedure of a print-correction controlling process, FIG. **4** is a flow chart of a procedure of a process to determine difficulty level to perform reprinting, and FIG. **5** is a plan view of a pattern for correcting process.

As an example of a job including a printing process, the printer **10** can execute three kinds of printing jobs, such as PC printing, copying, and facsimile-receiving. These printing

jobs are executed based on execution commands inputted from exterior and respectively have a different command-input route. That is, the execution command for PC printing is transmitted from e.g. a computer **50** and is input from the network interface **34**. The execution command for copying is input from the operation unit **26**. The execution command for facsimile-receiving is input from the facsimile interface **35**.

When being powered and being ready to receive a job, the CPU **30** waits for receipt of the execution command for a printing job at any one of the operation unit **26**, the network interface **34**, and the facsimile interface **35**. When the printing job is received, the print-correction controlling process shown in FIG. **3** starts.

The print-correction controlling process is for controlling the execution of the printing job and the correcting job. When the print-correction controlling process begins, the CPU **30** first executes a process to determine difficulty level of reprinting (S**101**). In this process, the difficulty level of performing reprinting after the printing job is completed is determined. The difficulty level is a value for evaluating troublesomeness or difficulty for reprinting.

In the present exemplary embodiment, whether the difficulty level of reprinting becomes a high or low level is determined based on the route via which the printing job is input. As shown in FIG. **4**, in determining the difficulty level of reprinting, if the printing job is received via the network interface **34** (S**201**: Yes), the CPU **30** determines the difficulty level of reprinting to be a high level (S**202**). Further, if the printing job is received via the facsimile interface **35** (S**203**: Yes), the CPU also determines the difficulty level of reprinting to be a high level (S**202**). Meanwhile, if the printing job is received via the operation unit **26** (S**203**: No), the CPU determines the difficulty level of reprinting to be a low level (S**204**).

The above-described determination is conducted based on following conditions. If the printing job is received via the network interface **34**, there is a possibility that a user commanding the printing (PC print) is at a place where the computer **50** is installed, and the place may be slightly distant from a place where the printer **10** is located. Thus, after the user transmits commands for executing the printing job, the user has to go to the place where the printer **10** is located in order to check the printing result, and if the user determines that reprinting is needed, the user needs to return to the place where the computer **50** is installed and repeat the preceding processes.

Meanwhile, if the printing job is received via the operation unit **26**, the user is likely to be near the printer **10**. Therefore, it is easy for the user to check the printing result and command reprinting. Furthermore, if the printing job is received via the facsimile interface **35**, a user who transmits a command for executing a printing job may be at a place far away from the place where the printer **10** is located. Therefore, reprinting may be more difficult to perform than the case where the printing job is received via the network interface **34**.

After determining the difficulty level in S**101** of FIG. **3**, the CPU **30** subsequently executes setting of a correction-performing condition based on the determination result. The correction-performing condition is a condition for determining whether to perform a correcting process or not, which will be described later. In the present exemplary embodiment, the correction-performing condition is regarded to be satisfied if the number of pages printed after a previous correcting process reaches a threshold value. The threshold value may be set to either a high number or a low number. If the difficulty level of reprinting is high (S**102**: Yes), the CPU **30** sets the threshold value to the low number (S**103**). If the difficulty level of reprinting is low (S**102**: No), the CPU sets the threshold value to the high number (S**104**). Thus, if the difficulty level of reprinting is high, the correction-performing condition is more easily satisfied than if the difficulty level of printing is low. The correction-performing condition may be modified adequately. For example, the correction-performing condition may be satisfied if a time lapse or a temperature change from a previous correcting process reaches a threshold value.

Subsequently, the CPU **30** determines whether or not the number of pages printed from the previous correcting process reaches the threshold value, i.e. whether or not the correction-performing condition is satisfied (S**105**). If the number of pages printed is larger than the threshold value, i.e. if the correction-performing condition is satisfied (S**105**: Yes), the CPU subsequently determines whether or not the next page to be printed is a color page (S**106**). If the page is a color page (S**106**: Yes), the correcting process is performed (S**107**).

Hereinafter, the correcting process is exemplified as position correction that is performed for correcting a positioning gap of an image-forming position. When the correcting process begins, the CPU **30** forms a pattern P, shown in FIG. **5**, on the conveyor belt **16**, using the printing unit **15**. This pattern P is composed of two rows of thin, long marks **55**K, **55**Y, **55**M, and **55**C of different colors, wherein in each row, a plurality of mark sets are arranged spaced in a sub-scan direction, each mark set including four marks **55**K to **55**C arranged in the order of black, yellow, magenta, and cyan.

Subsequently, the CPU **30** measures timing when the respective marks **55**K to **55**C of each mark set pass through a detection position of the pattern sensor **28**. According to the measured result, the CPU **30** obtains an amount of the positioning gap in the sub-scan direction, for each different color (called corrected color) marks **55**Y, **55**M, and **55**C, relative to the black mark **55**K. Then, the CPU calculates an average value of the amount of the positioning gap among the respective corrected colors, for each of the respective mark sets, and calculates a corrected value to offset the average value of the positioning gap, and stores the corrected value in the NVRAM **33**, and completes the correcting process.

Meanwhile, the user can input an execution command for correction via the computer **50** in connection with the operation unit **26** or the network interface **34**, and upon receipt of the correction execution command, the CPU **30** performs the correcting process irrespective of whether the correction-performing condition is satisfied or not.

After completing the correcting process in S**107** of FIG. **3**, the CPU **30** executes a printing process where the printing unit **15** prints a single page of the printing job (S**108**). During the execution of the printing job, the CPU **30** performs the correction of the position of an image by reading out the corrected value stored in the NVRAM **33** during the correcting process, and by supplying, to the printing unit **15**, print data, the print position of which is corrected based on the corrected value.

Meanwhile, if the number of print pages is determined to be below the threshold value in S**105** (S**105**: No), or that the print page is monochrome in S**106** (S**106**: No), the CPU **30** executes a printing process of printing a single page of the printing job in S**108**, without executing the correcting process. The process may be configured such that, the processing of determining whether the print page is a color page in S**106** is omitted, and the correcting process is always performed if the number of print pages is larger than the threshold value (the case that the correction-performing condition is satisfied).

Subsequently, the CPU **30** determines whether or not the targeted printing job has been completed (S**109**). If it is deter-

mined that the targeted printing job has not been completed (S**109**: No), whether or not the difficulty level of reprinting has been determined to be a high level in the process of S**101**, is determined (S**110**). If the difficulty level of reprinting is determined to be a high level (S**110**: Yes), the process returns to S**108** and printing of a next page is performed. Meanwhile, if the difficulty level of reprinting is determined to be a low level (S**110**: No), the process returns to S**105** and the correction-performing condition is determined. The CPU **30** completes the print-correction controlling process if all pages of the printing job have been printed out (S**109**: Yes).

That is, in the print-correction controlling process, if the difficulty level of reprinting of certain pages of the printing job is determined to be a low level, whenever a page is printed, the process of S**105** of determining the correction-performing condition is executed. Therefore, the correcting process may be performed during printing. Meanwhile, if the difficulty level of reprinting is determined to be a high level, the correcting process may be executed only at the time before a first page is printed. Therefore, no correcting process is executed during printing.

Effects of the First Exemplary Embodiment

According to the above-described first exemplary embodiment, the difficulty level of reprinting is determined based on via which unit among the operation unit **26**, the network interface **34**, and the facsimile interface **35**, has the printing job been received, and as the difficulty level increases, the correction-performing condition is more easily satisfied. In other words, the difficulty level to satisfy the correction-performing condition varies according to an input route of a printing job.

It is considered that the troublesomeness for a user checking the printed image and performing reprinting varies depending on whether the place where the printing job is input is close to the printer **10** or not. Thus, the difficulty level of reprinting is determined based via which reception unit has the printing job been received. As the difficulty level increases, the correcting process is made easier to perform, and to the contrary, as the difficulty level decreases, the correction process is made difficult to perform. Accordingly, frequency of performing the correcting process can be restricted, and a need to perform a troublesome reprinting is reduced, resulting in improvement in convenience for the user.

Further if the printing job is received via facsimile communication, the difficulty level of reprinting is determined to be higher than the difficulty level of reprinting when the printing job is received via other unit. Thus, if the printing job is received via facsimile reception, the correction-performing condition is set so as to be more easily satisfied than other cases, and the correcting process is more easily performed. In order to perform reprinting of the facsimile received printing job, a user needs to request re-transmission to a sender, and thus, in many cases, it is relatively troublesome or difficult to perform the reprinting. By the correcting process being performed more easily when the printing job is received via facsimile communication, occurrence of such a need is avoided.

Further, if the correcting process is performed during the execution of the printing job, an image quality may vary before and after the correcting process, and may result in deterioration of visual quality. According to the above-described embodiment, if the difficulty level of reprinting is higher than a reference value, no correcting process is performed during printing, and thus, the deterioration of visual quality due to change in image quality can be prevented. Further, if the difficulty level of reprinting is lower than a reference value, the correcting process is performed during printing, and thus, a high image quality can be ensured. Even when a user determines that reprinting is needed due to change of image quality, reprinting can be easily performed.

Monochrome printing is considered to have less influence on a positioning gap or a density gap, compared to color printing. Thus, if the printing job is monochrome printing, even when the correction-performing condition is satisfied, no correcting process is performed, thereby restricting performing frequency of the correcting process together with an influence on an image quality.

Further, the process may be configured so that the processing of S**201** is omitted, and the CPU only determines whether or not a printing job is received via the facsimile interface **35** in S**203**, and if it is received via the facsimile interface **35** (S**203**: Yes), the difficulty level is determined to be high (S**202**).

That is, if a printing job is received via facsimile communication, the correction-performing condition is more easily satisfied than other cases where the printing job is received via other unit. Since reprinting of the printing job received via facsimile communication is relatively troublesome or difficult, by the correcting process being performed more easily when the printing job is received via facsimile communication, occurrence of need of such a reprinting is avoided.

Second Exemplary Embodiment

The second exemplary embodiment of the present invention will now be described with reference to FIG. **6**.

FIG. **6** is a flow chart of a procedure of a process to determine difficulty level of reprinting. The second exemplary embodiment has the same basic configuration of the printer **10** and the same print-correction controlling process as those of the first embodiment, except that the process to determine the difficulty level of reprinting replaces that of the first exemplary embodiment.

The printer **10** of the present embodiment has a reprinting function that makes it possible to easily perform reprinting. The reprinting function can be set to ON (available state) or OFF (unavailable state) according to commands from the operation unit **26**. If the reprinting function is available, the CPU **30** stores print data used in printing (the print data unit original raw data or data processed for printing) in the RAM **32**, for a certain period after the printing is completed, whenever printing is performed. When a user checks the printing result and determines reprinting is needed, the user commands performing reprinting. Thereby, the CPU **30** reads out the aforementioned data from the RAM **32** and performs reprinting (reprinting process). Thus, by use of the reprinting function, a user can reduce time to input the same data again to the printer **10**.

In the process of FIG. **6** of determining the difficulty level of reprinting, the CPU **30** determines whether the reprinting function is in an OFF state or not (S**301**), and if it is in the OFF state (S**301**: Yes), the CPU determines the difficulty level of reprinting to be high (S**302**). Meanwhile, if the reprinting function is in an ON state (S**301**: No), the CPU determines whether all data of a printing job can be stored in the RAM **32** or not (S**303**). If an amount of data of the printing job is unknown, the process may be configured such that the amount of data is estimated from a number of pages of the printing job, and whether an area for storing the data can be secured in the RAM **32** or not may be determined. Instead of using the amount of data, if the RAM **32** has a certain amount

of empty storage space, it may be determined that the data can be stored in the RAM **32**. Meanwhile, even if the reprinting function has been set to an ON state, if all of the data of the printing job were unable to be stored in the RAM **32** during printing, the reprinting function cannot be performed.

When the area for storing all data of the printing job cannot be ensured in the RAM **32** (S**303**: No), the CPU **30** determines the difficulty level of reprinting to be high in S**302**, and when there is an empty storage space in the RAM (S**303**: Yes), the CPU determines the difficulty level to be low (S**304**). Thus, when the reprinting function is in an OFF state, or there is no sufficient empty storage space in the RAM **32**, the difficulty level is determined to be high, so that the correction-performing condition is easily satisfied.

According to the above-described exemplary embodiment, if the reprinting cannot be performed, the difficulty level of reprinting is determined to be higher than if the reprinting can be performed. The correction-performing condition becomes easier to satisfy as the difficulty level of reprinting increases. In other words, if reprinting cannot be performed, the correction-performing condition becomes easier to satisfy than when the reprinting can be performed.

That is, if the reprinting process can be performed, the correcting process is made difficult to perform, thereby restricting frequency in performance of the correcting process. Further, if the reprinting process cannot be performed, the correcting process is made easier to be performed, thereby reducing needs for performing troublesome reprinting, which improves the convenience for the user.

Third Exemplary Embodiment

The third exemplary embodiment of the present invention will now be described with reference to FIGS. **7** and **8**. FIG. **7** is a block diagram illustrating the schematic configuration of a printer **60**, and FIG. **8** is a flow chart illustrating a process to determine difficulty level to perform reprinting.

The printer **60** of the present exemplary embodiment includes a toner level sensor **61** and a paper level sensor **62**, in addition to the configuration of the printer **10** of FIG. **2**. The other configuration of the printer **60** is identical to that of FIG. **2**. The content of the print-correction controlling process is also equal to that of the first exemplary embodiment.

The toner level sensor **61** (an example of a detecting unit) transmits light to the toner bin of the respective processing unit **18** and detects the remaining amount of toner based on the amount of transmitted light. The paper level sensor **62** (an example of a detecting unit) brings an actuator into contact with an upper surface of a sheaf of papers stacked in a feed tray **12** and detects the remaining amount of the papers **11** based on a position of the actuator.

In the process of FIG. **8** of determining the difficulty level of reprinting, the CPU **30** determines whether or not the remaining amount of toner is equal to or less than a predetermined reference value based on the detecting result by the toner level sensor **61** (S**401**), and if the remaining amount is equal to or less than the reference value (S**401**: Yes), the CPU determines the difficulty level of reprinting to be high (S**402**). Meanwhile, if the remaining amount of toner exceeds the reference value (S**401**: No), the CPU determines whether or not the remaining amount of papers is equal to or less than a predetermined reference level based on the detecting result by the paper level sensor **62** (S**403**). If the remaining amount of papers is equal to or less than the reference value (S**403**: Yes), the difficulty level of reprinting is determined to be high (S**402**), and if the remaining amount of papers exceeds the reference value (S**403**: No), the difficulty level is determined to be low (S**404**).

According to the above-described embodiment, as the remaining amount of toner or paper **11**, which are consumable print materials, decreases, the difficulty level of reprinting is determined to be high. As the difficulty level increases, the correction-performing condition is subject to being satisfied. In other words, the correction-performing condition becomes easier to satisfy as the amount of consumable print materials remaining decreases.

That is, if the remaining amount of consumable print materials is low, when performing reprinting, it is likely that the consumable print material becomes insufficient, and the user is likely to perform a troublesome process of supplying the consumable print material. Thus, in case that the remaining amount of consumable print materials is low, the correcting process is made easier to perform, thereby reducing the need for performing a troublesome reprinting process. Additionally, if the remaining amount of consumable print materials is sufficient, the correcting process is made difficult to perform, thereby restricting frequency in performance of the correcting process. Thereby, the convenience for the user is improved.

Reference Embodiment

The invention may be configured as follows:

In the printer **10** of FIG. **2**, a user registers, via the operation unit **26** or the like, corresponding information in advance, which is information obtained by matching user information (a user name, a computer name, etc) with the difficulty level of satisfying a correction-performing condition, and the CPU **30** stores the corresponding information in the NVRAM **33** or the like. Then, upon receipt of a printing job, the CPU **30** specifies the user who input the printing job.

Specifically, for example, if the printing job is transmitted from a computer, a user name, a computer name, or the like may be attached to an execution command for the printing job. Further, if the printing job is input from the operation unit **26**, an authentication unit such as a card key or the like may be provided in the printer **10** so that a user name may be taken by authentication. Then, the CPU **30** sets a correction-performing condition corresponding to a specified user based on the above-mentioned corresponding information. Thus, the correction-performing condition can be changed based on the user.

Moreover, a following exemplary embodiment may be realized by combination of the reference embodiment with the invention.

For example, registration is done in advance for every user on whether or not he/she is allowed or disallowed to use a reprint function, and if a printing job is input by a disallowed user, the correction-performing condition becomes easier to satisfy than when the printing job is input by an allowed user.

Registration is done for every user on whether a place where a seat or a computer exists is close to or far away from a printer, and if a printing job is input by a far user, the correction-performing condition becomes easier to satisfy than when the printing job is input by a close user.

Other Exemplary Embodiments

The present invention is not limited to the aforementioned exemplary embodiments. For example, following exemplary embodiments may be involved within the technical scope of the present invention.

(1) The above-described exemplary embodiments described an example that the invention is adapted to an electrophotographic color printer. However, the present invention may also be applicable to e.g. printing apparatuses for monochrome printing only, or an ink-jet type printing apparatus or other type printing apparatuses. Further, as print agents, ink or the like may be used other than toner.

(2) The above-described exemplary embodiments described the correcting process that corrects relative positioning gap between the respective colors. However, the present invention may be configured, for example, so that periodic gap of an image forming position due to heterogeneous rotation of e.g. a photosensitive drum or a belt is measured, with the result that record timing upon exposure is adjusted thereby correcting the periodic gap. Furthermore, the correcting process may be performed such that non-uniformity of a density of an image is measured and corrected.

(3) The procedure of the respective flow chart may be modified without departing from the scope of the invention, so that for example, a portion of the procedure may be omitted or combined, or a portion of a condition may be changed. For example, the difficulty level may be determined in, either of S**201** or S**203** of FIG. **4**, either of S**301** or S**303** of FIG. **6**, or either of S**401** or S**403** of FIG. **8**, or otherwise the difficulty level may be determined by combination of these processes.

(4) The above-described exemplary embodiments have described that the difficulty level has two levels. However, according to the present invention, the difficulty level may be of three or more levels and the correction-performing condition may be changed accordingly. For example, the process may be configured such that the difficulty level is divided into three-stage level, i.e. high, middle, and low, and if an input source of a printing job is a facsimile, an external computer, or an operation unit, the difficulty level is determined to be high, middle, or low, respectively, so that the correction-performing condition may vary in three levels where the condition is satisfied easier as the difficulty level becomes higher.

(5) The above-described exemplary embodiments have described that if difficulty level of reprinting is high, no correcting process is performed during printing. However, according to the present invention, even in high difficulty level, the correcting process may be performed during printing. By this performance, high image quality can be ensured.

(6) The above-described exemplary embodiments have described that three kinds of printing jobs, including PC printing, copying, and fax-receiving, can be performed. However, according to the present invention, the printing jobs capable of being performed may be changed arbitrarily. The printing job may be configured such that e-mail printing can performed, in a manner that e-mail is received from a mail server on the Internet via the network interface, and an image attached thereto is printed. Further, direct printing, wherein an USB interface or other media connector is provided as a reception unit so that when a media such as flash memory is connected to the media connector, image data stored in the media is read out and printed, may also be capable of being performed. Meanwhile, the e-mail printing may be considered to have higher difficulty level of reprinting than that of the printing job input via the operation unit, and the direct printing may be considered to have relatively low difficulty level of reprinting, similar to the printing job from the operation unit.

What is claimed is:

1. A printing apparatus comprising:

a reception unit configured to receive a printing job;

a printing unit configured to print based on the print job received by the reception unit;

a processor; and

a memory storing instructions, when executed by the processor, causing the printing apparatus to:

determine whether a reprinting function is set or not, wherein, when the reprinting function is set, the printing job printed by the printing unit is stored in the memory and is reprinted by the printing unit based on a command from a user;

set a threshold for determining whether a correction-performing condition is satisfied, wherein a first threshold is set when the reprinting function is not set, and a second threshold is set when the reprinting function is set, the first threshold being less than the second threshold;

when the reprinting function is not set,

determine whether a current printing-related value, which is related to the printing, has reached the first threshold;

if the current printing-related value has reached the first threshold during execution of the print job, perform a correcting process including:

causing the printing unit to form a pattern on a medium; measuring the pattern formed on the medium; and correcting, based on the received printing job, the image to be printed in accordance with a measurement result of the pattern, and cause the printing unit to print the image corrected by the correcting process;

if the current printing-related value has not reached the first threshold during execution of the print job, cause the printing unit to print the image without performing the correcting process; and

when the reprinting function is set,

determine whether a current printing-related value, which is related to the printing, has reached the second threshold;

if the current printing-related value has reached the second threshold during execution of the print job, perform a correcting process including:

causing the printing unit to form a pattern on a medium; measuring the pattern formed on the medium; and correcting, based on the received printing job, the image to be printed in accordance with a measurement result of the pattern, and cause the printing unit to print the image corrected by the correcting process;

if the current printing-related value has not reached the second threshold during execution of the print job, cause the printing unit to print the image without performing the correcting process.

2. A printing apparatus comprising:

a reception unit configured to receive a printing job;

a printing unit configured to print based on the print job received by the reception unit and configured to perform both color printing and monochrome printing;

a processor; and

a memory storing instructions, when executed by the processor, causing the printing apparatus to:

determine whether a reprinting function is set or not, wherein, when the reprinting function is set, the printing job printed by the printing unit is stored in the memory and is reprinted by the printing unit based on a command from a user;

set a threshold for determining whether a correction-performing condition is satisfied, wherein a first threshold is set when the reprinting function is not set,

and a second threshold is set when the reprinting function is set, the first threshold being less than the second threshold;

when the reprinting function is not set,

determine whether a current printing-related value, which is related to the printing, has reached the first threshold;

if the current printing-related value has reached the first threshold during execution of the print job and if the printing job is for the color printing, perform a correcting process including: causing the printing unit to form a pattern on a medium; measuring the pattern formed on the medium; and correcting, based on the received printing job, the image to be printed in accordance with a measurement result of the pattern, and cause the printing unit to print the image corrected by the correcting process;

if (i) the current printing-related value has not reached the first threshold during execution of the print job, or (ii) if the printing job is for the monochrome printing while the current printing-related value has reached the first threshold during execution of the print job, cause the printing unit to print the image without performing the correcting process; and

when the reprinting function is set,

determine whether a current printing-related value, which is related to the printing, has reached the second threshold;

if the current printing-related value has reached the second threshold during execution of the print job and if the printing job is for the color printing, perform a correcting process including; causing the printing unit to form a pattern on a medium; measuring the pattern formed on the medium; and correcting,

based on the received printing job, the image to be printed in accordance with a measurement result of the pattern, and cause the printing unit to print the image corrected by the correcting process;

if (i) the current printing-related value has not reached the second threshold during execution of the print job, or (ii) if the printing job is for the monochrome printing while the current printing-related value has reached the second threshold during execution of the print job, cause the printing unit to print the image without performing the correcting process.

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